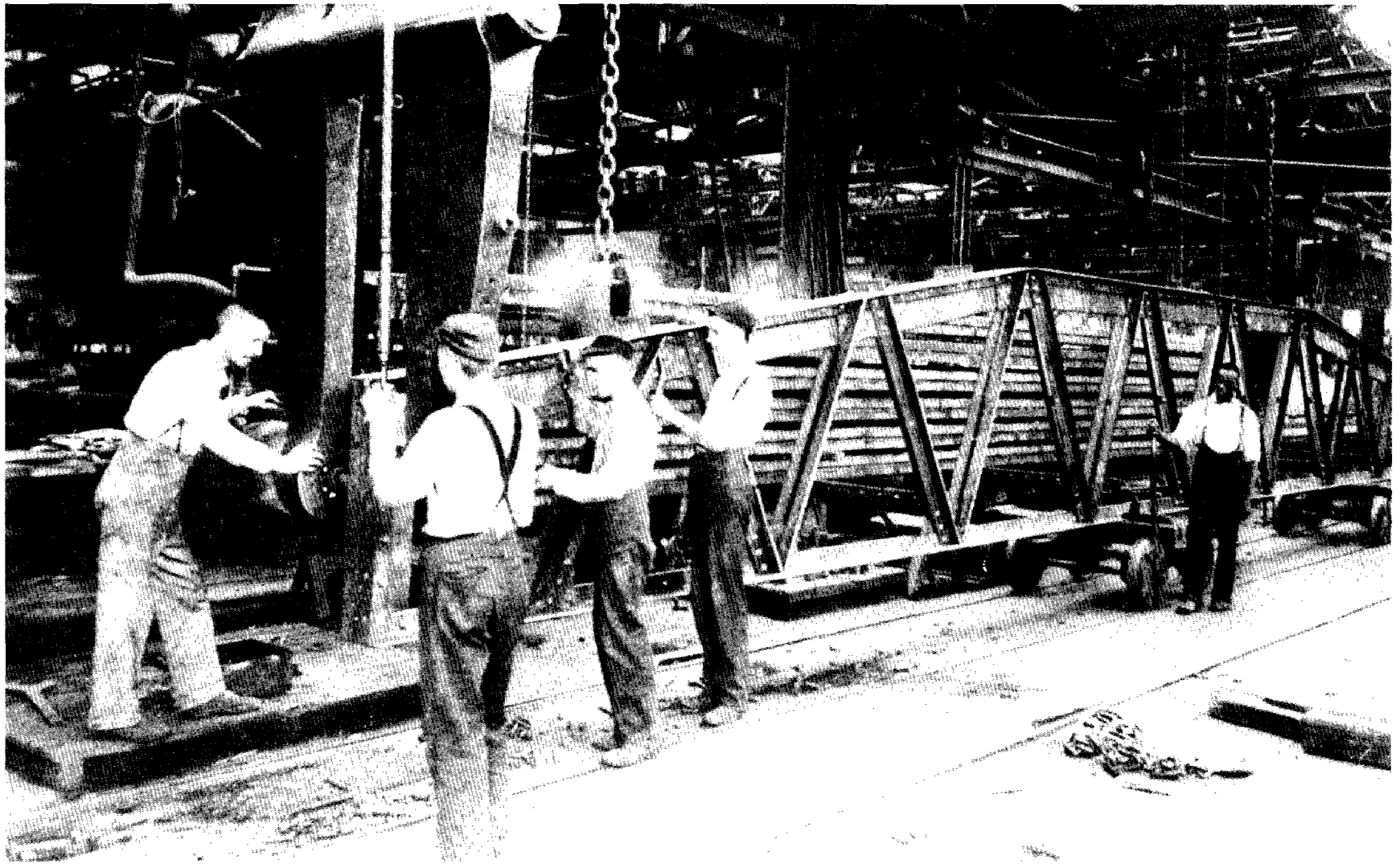
METAL TRUSS BRIDGES



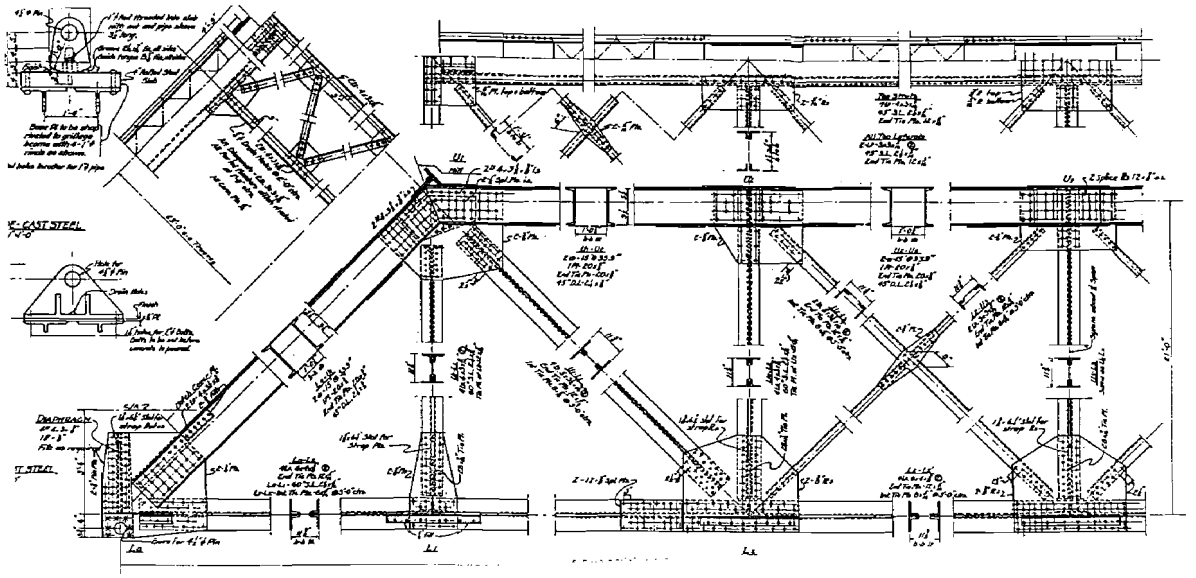
Small prefabricated truss being assembled at Edge Moor Iron Works.

METAL TRUSS BRIDGES

There are six remaining historic metal truss bridges still carrying highways in Delaware. One of these is a Pratt through truss and five are Warren pony trusses. In Delaware, as in other mid-Atlantic states, the metal truss was a frequently utilized type for highway bridges. Delaware Department of Transportation photographic archives for New Castle County illustrate that in New Castle County in the 1920s-1930s there were at least ninety metal truss highway bridges, primarily Pratt and Warren pony trusses. At that time, photographs indicate that the through truss was a rare resource; only three through trusses are included in these early New Castle County bridge archives. Other early metal highway truss bridges seen in these archives include a bowstring pony truss, a cast iron and steel truss bridge, and a double-span truss bridge, photographs of which are seen at the end of this introduction. These bridges no longer survive.

The truss bridge was developed in direct response to the evolution and growth of America's transportation network. Its significance was recognized early because it was adaptable to a wide variety of site conditions, its structural behavior was scientifically understood, and its prefabricated components made it easy and economical to manufacture, ship, and erect. In 1916, prominent bridge engineer J. A. L. Waddell wrote that the last form of bridge construction to be evolved, but the one destined to promote the highest development of the art of bridge building, was the truss. The truss bridge type was originally constructed in wood and was usually covered by a roof and side-wall sheathing resulting in the well-known covered bridge. Two examples of uncovered wooden trusses and numerous examples of covered wooden trusses are listed in the photographic archives for New Castle County. These are described in the Timber Bridge section of this report. Developments in technology are reflected in the changing form of the truss bridge. As materials changed from wood to combined wood and iron, to cast and wrought iron, and finally to steel, the truss bridge form reflected responses to needs for greater span and load capacity, mingled with manufacturing improvements in first irons, then steel. The metal truss was a structural form which suited the tremendously rapid technological and geographical progress of 19th century railroad and early 20th century highway travel in the United States.

The metal truss bridge was popular well into the twentieth century because of, as mentioned above, its relative ease of



Details from original 1927 drawings for Bridge 1.

construction: field construction of a metal truss bridge could be accomplished with unskilled labor and little equipment. Small spans could be fabricated, assembled, shipped and quickly erected on the completed substructure which was often constructed by local labor. The photograph at the beginning of this section shows a small truss being prefabricated. For larger spans, the individual truss members were fabricated and riveted at the truss works and shipped to the site, where the truss was assembled by matching the marked members and inserting pins at the joints.

Metal truss bridges were also popular because of the tendency of manufacturers to encourage standardization. Many well-known bridge companies sold metal truss bridges by type through mail order catalogs. According to an 1873 catalog of the Phoenixville Bridge Works of Phoenixville, Pennsylvania, the customer was directed to "follow directions and provide information concerning:

1. Style of bridge, span length, width of piers

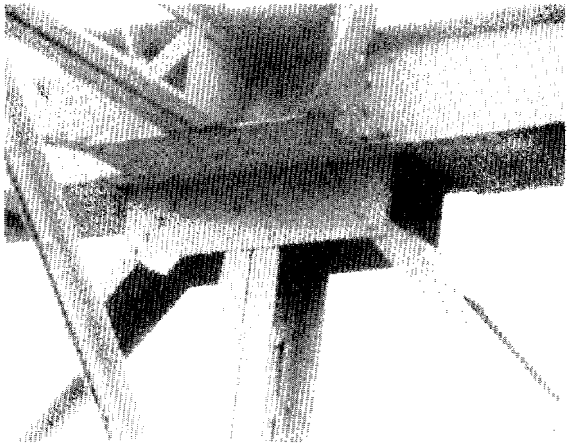
2. Bridge at right angles, or angle of skew

3. Height of bottom rail above stream bed

4. Who will build the substructure, railroad company, [county, municipality] or bridge company, and if bridge company then...

5. Depth of water, if piles are required by the nature of the bottom of the stream bed.

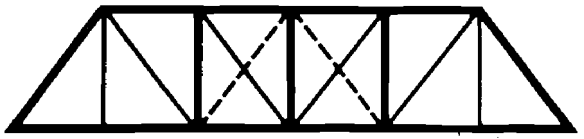
When this data was furnished, the company promised to (1)"quote prices, by return mail" and (2) "construct the bridges in as short a time as any other bridge builder can do."



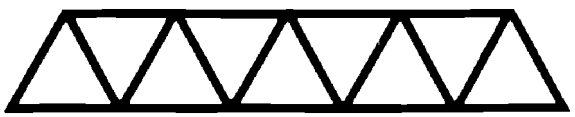
Bridge 1 truss joint detail.

Different truss types have different capabilities and characteristics and there developed diverse forms, with a multitude of proprietary types registered at the U. S. Patent Office. Truss bridges are structures whose individual components are connected in a series of triangles. Metal truss types are differentiated by the arrangement of the component triangles and the way that individual members are stressed. Two early and common metal truss forms are represented among those remaining in Delaware: the Pratt truss and the Warren truss. Five of the remaining metal truss highway bridges in Delaware are Warren pony trusses, two of these built by the prominent Edge Moor Bridge Works. The sixth remaining metal truss bridge, Rising Sun Bridge (State Bridge #1) is a Pratt through truss designed by Harrington, Howard and Ash, a nationally significant firm whose principals had been associated with J.A.L. Waddell. This firm, described in the Movable Bridge section, also specialized in movable bridges and was responsible for some of the movable bridges in Delaware.

The Pratt truss type, illustrated on the following page, was widely used from the mid-nineteenth to the early twentieth century for simple highway bridges. Patented in 1844 by Thomas and Caleb Pratt, the original design was for a composite timber and iron truss, wherein the iron diagonals resisted tension and the timber members resisted compressive loads. The Pratt configuration easily adapted into an all metal truss, first built of iron and then steel.



Pratt Truss

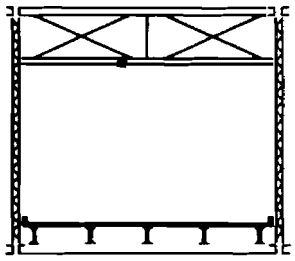


Warren Truss

Compared with its contemporaneous competitor, the Howe truss, it was more economically suited to the transition in material. Its tension diagonals could be made of small bars or rods, and its compressive members were shorter than those of the Howe form and could better resist buckling for a given cross-section. The Pratt truss became the predominant metal truss bridge type built in the United States after 1860.

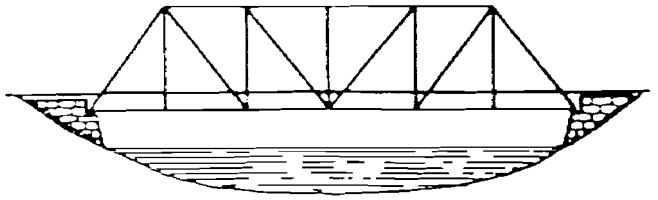
The Warren pony truss type, as seen above, employed standardized members and is typical of the small spans erected along local roadways in rural areas throughout the country in response to increasing traffic in the late nineteenth and early twentieth centuries. The Warren truss was patented in 1848 by two British engineers, James Warren and Willoughby Monzoni. Originally a series of equilateral triangles, this form represents one of the earliest truss types. Later modifications included subdivision by verticals or addition of alternate diagonals. While few metal truss highway bridges remain in Delaware, five of the six that survive are Warren pony trusses. This truss form was widely built throughout most of the United States from about 1860 and into the twentieth century.

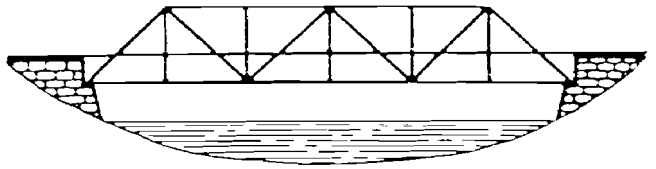
Further classification of truss bridges is made on the basis of the location of the bridge deck in relation to the top and bottom chords and by their structural behavior. Most commonly the deck is located inside the main trusses with floor beams attached to the bottom of the verticals and lateral bracing connecting the trusses above as in the through truss seen below. This is represented in Delaware by State Bridge Number 1. If the truss does not have enough depth for lateral bracing,it is called a "pony truss" or "half through truss" as seen in the adjacent diagram. This is represented by the other five remaining metal truss bridges in Delaware. According to photographic records at Delaware Department of Transportation, there were, at one time, large numbers of these pony trusses in New Castle County.



Through Truss

Pony Truss *Section*





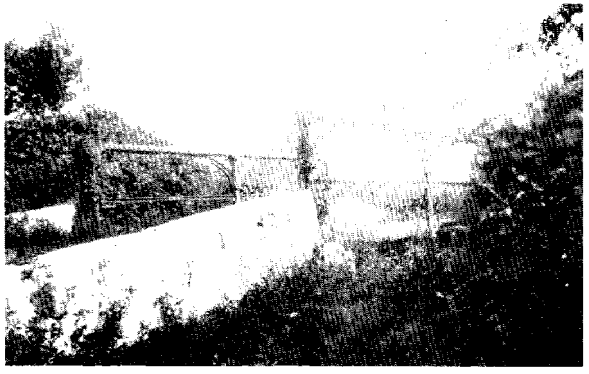
Elevation

METAL TRUSS

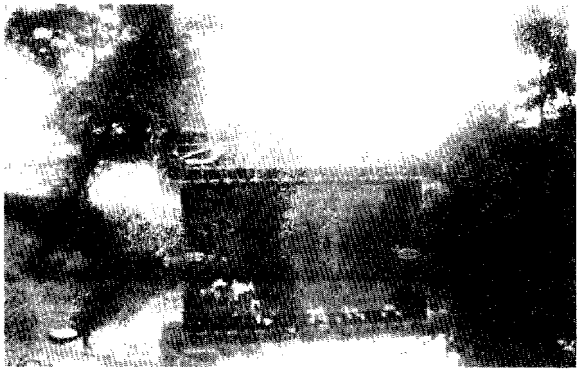
The Edge Moor Bridge Works, seen in the photograph at the beginning of this section, built several of these pony trusses in New Castle County between 1880 and 1900. The two surviving examples of their work are State Bridge Number 66 and the Wiggins Mill Pond Bridge, State Bridge 424. According to Delaware Department of Transportation photographic archives for New Castle County, at least two additional bridges, no longer surviving, were fabricated by Edge Moor Iron Company. Located on the banks of the Delaware River just north of Wilmington, the Edge Moor Iron Company was incorporated in 1869 as an iron rolling mill for the manufacture of iron for general purposes. Under the direction of president William Sellers, the company evolved into a manufacturer of structural iron and steel for bridges, viaducts and roof work. In 1873, the Edge Moor Bridge Works was established for the fabrication of bridges. In 1879, the company diversified by including boilers as one of their products. The Edge Moor Bridge Works was operational until 1900 when it was acquired by the American Bridge Company of New Jersey. Edge Moor was one of twenty-four bridge companies purchased by J. P. Morgan's American Bridge Company in 1900. At that time, American Bridge purchased the 14 acre parcel from the Edge Moor Bridge Works and assumed control of the bridge manufacturing operations while the Edge Moor Iron Company concentrated on the production of Galloway Boilers. American Bridge operated the bridge division at Edge Moor for a time, but then consolidated its holdings at its Ambridge, Pennsylvania location. The Edge Moor Iron Works continued as a manufacturer of boilers and tanks until its liquidation in 1933.

The Bridge Works fabricated bridges for locations throughout the East, such as over the East River in New York City, the Susquehanna River near Harrisburg, Pennsylvania and the Pennsylvania Railroad Bridge over Schuylkill River in Philadelphia. The American Bridge Company is responsible for portions of the construction of State Bridge Number 3, a steel girder bridge in New Castle County, and State Bridge Number 577, a bascule bridge also in New Castle County.

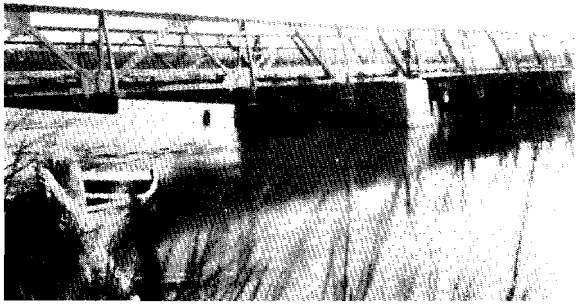
EARLY NEW CASTLE COUNTY TRUSS BRIDGES



Cast Iron Truss Bridge
Red Lion Creek, New Castle County
No longer standing.



Bowstring Truss Bridge
"Welch Tract Baptist Church", New Castle County
No longer standing.



Multi-span Metal Truss Bridge
near Fleming's Landing,
New Castle County
No longer standing.

State Bridge 1: Rising Sun Bridge

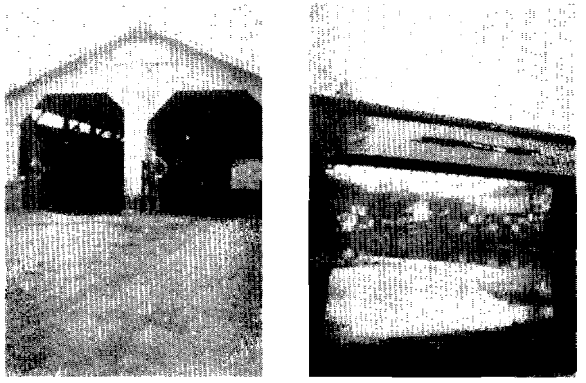
STATE BRIDGE 1

State Bridge Number 1
Rising Sun Lane
over Brandywine Creek
Wilmington, New Castle County, Delaware
1928/79

State Bridge 1 (Rising Sun Bridge) comprises a 123'-0" riveted Pratt through truss and a stone arch span for an overall length of 193'-6". The inclined end posts of the 6-panel truss consist of riveted channels with cover plates; the intermediate sway bracing posts and bottom chords are made of laced double angles, and the top chord consists of laced channels. Diagonals are made of angles with stay plates; lateral bracing consists of laced angles. There is a 5'-0" walkway cantilevered off the east elevation. The decorative metal railing has lattice below with scrolls and a pipe handrail above. The deck is supported on seven transverse girders spanned by three longitudinal I-beams. The truss is supported on uncoursed ashlar abutments with U-shaped rubble stone wing walls with decorative coping; incorporated within the south approach wall is a 25'-0" segmental arch span. The bridge carries two lanes of traffic on a 20'-0" roadway; the truss span measures 14'-0" high from the deck to the sway struts.

The Levy Court of New Castle County authorized the construction of the Rising Sun Bridge. The total cost, including preliminary surveys, advertising costs, engineering fees and construction amounted to $23,985.80.

A plaque on the south portal records the construction of the truss in 1928 by the Standard Engineering and Contracting Company of Middlesex, New Jersey, with consulting engineers Harrington, Howard, and Ash. This Kansas City, Missouri, engineering firm specialized in the design of movable bridges; more information concerning this firm is located in the Movable Bridge section of this report.

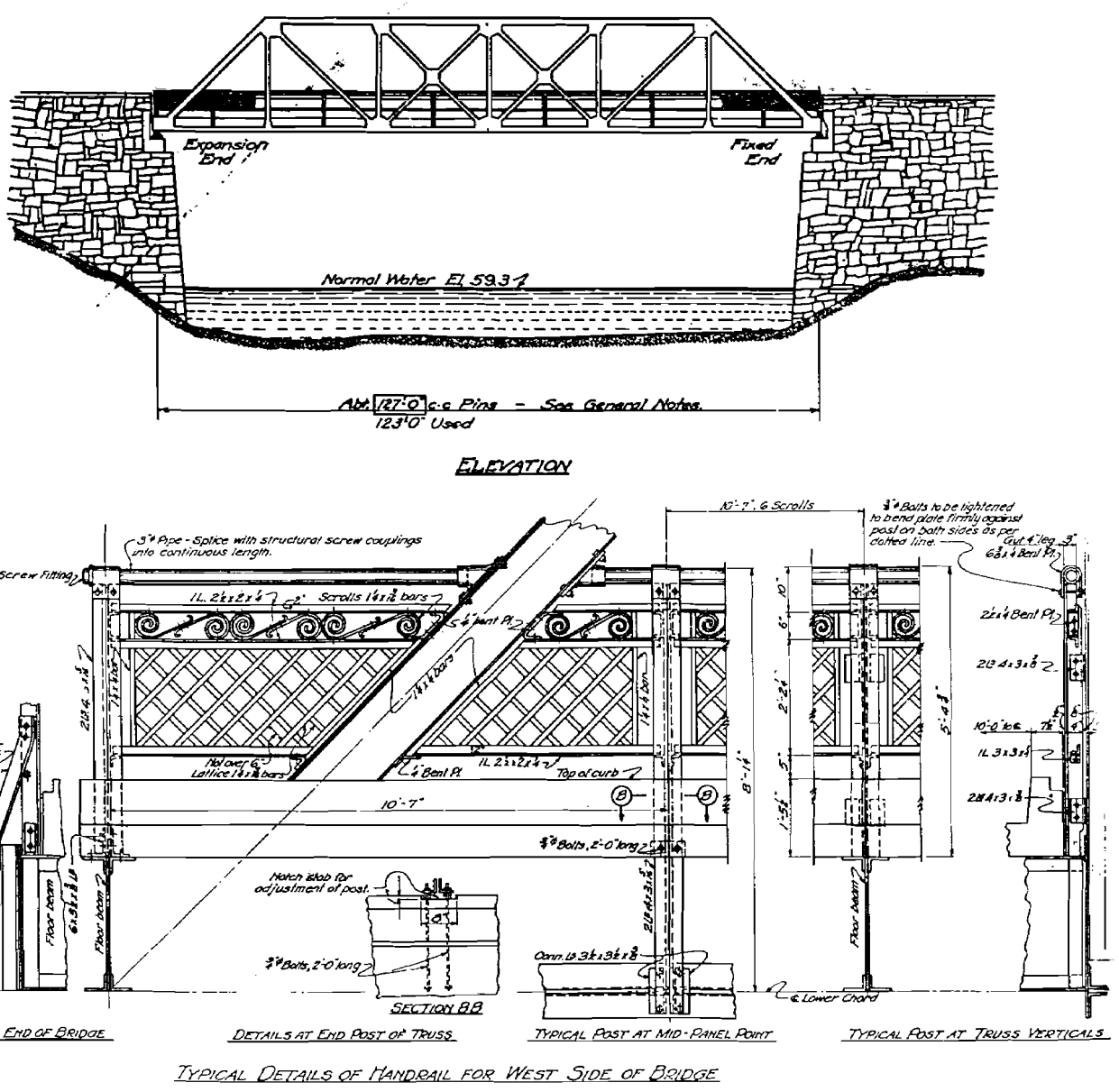


Rising Sun Bridge before 1928 replacement.

METAL TRUSS

Delaware Department of Transportation records state that Bridge 1 was built in 1928. The original Rising Sun bridge, constructed in 1883, was a timber covered bridge comprising a Burr truss spanning 124 feet and supported on massive granite abutments. It is pictured in this section. The bridge measured 22 feet in width and functioned until 1927 when demolished for the construction of existing Bridge 1, a steel truss. The current bridge utilized the existing abutments. Original drawings from 1927, excerpts from which appear adjacent, document the configuration and construction of the bridge. The bridge opened to traffic in 1928. 1968 drawings indicate replacement of some of the railings, angles, and rivets in such a fashion as to be "an exact duplicate of the existing members". In 1979, extensive repairs were performed on the deck, closing the span for over one year. The granite masonry arch spans what was originally a mill race; it was constructed c. 1830.

State Bridge 1 is the only extant through truss still carrying highway traffic in Delaware. Although Delaware Department of Transportation photographic archives from the 1920s illustrate approximately ninety metal truss bridges in New Castle County, only three of those were through trusses, thus indicating that it was a rare resource in Delaware even at that time.



Details from original 1927 drawings for Bridge 1.

State Bridge 66

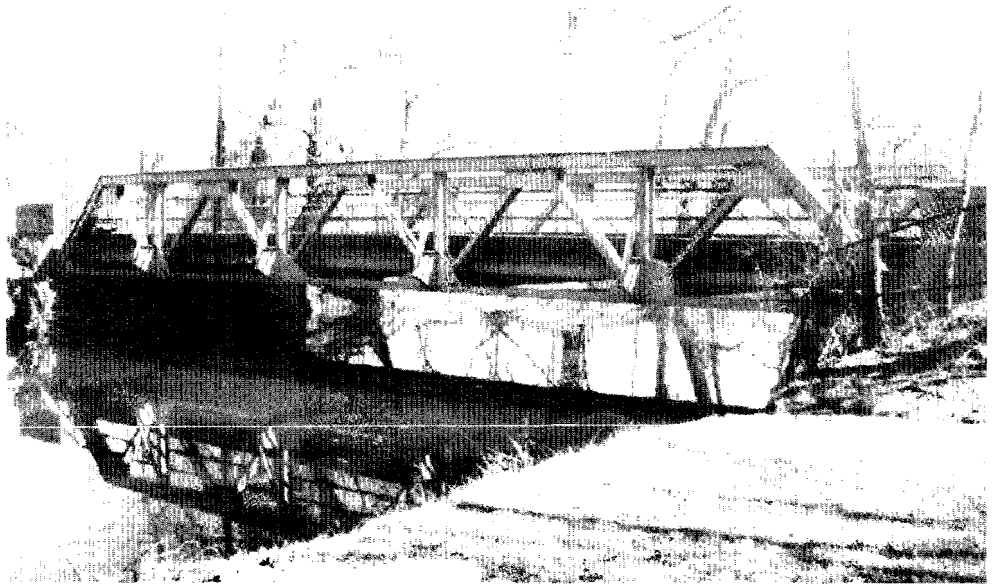
STATE BRIDGE 66

Brecks Lane over Brandywine Creek Tributary
Wilmington, New Castle County, Delaware

State Highway Bridge 66 is a 21'-0" riveted Warren pony truss, divided into two panels. The top and bottom chords are made of double 4"x4" angles; posts are 3"x4" angles, and diagonals are double 3"x3" angles. A transverse floor beam encased in concrete and measuring 8½"x16" is located at the intermediate panel point; the longitudinal girders are encased within the concrete deck. The bridge carries two lanes of traffic, and measures 20'-8" wide. It is supported on random rubble stone abutments with U-shaped stone wing walls.

Delaware Department of Transportation records for Bridge 66 do not document the date of construction. Located near Breck's Mill, Bridge 66 is very similar to Bridge 179A, carrying the Ashland Cut-off over Mill Creek. It was built by the Edge Moor Bridge Works of Wilmington, Delaware. The Edge Moor Bridge Works built several of these pony trusses in New Castle County between 1880 and 1900. Another surviving example of their work is the Wiggins Mill Pond Bridge, Bridge 424. Later alterations to Bridge 66 included the replacement of the original timber deck with a concrete slab and the encasement of the floor beam and I-beam stringers in concrete.

Despite the fact that Bridge 66 appears to be in deteriorated condition, it is significant as one of six remaining historic metal truss highway bridges in Delaware, and for its association with the prominent Edge Moor Bridge Works. In its Warren pony truss configuration employing standardized members, Bridge 66 is typical of the small spans erected along local roadways in rural areas throughout the country, in response to increasing traffic in the late nineteenth and early twentieth century. Structures like Bridge 66 and the other pony trusses shown here played a vital role in the economic development of rural areas during the last quarter of the nineteenth century and well into the twentieth century, as local transportation networks underwent the initial phases of development.



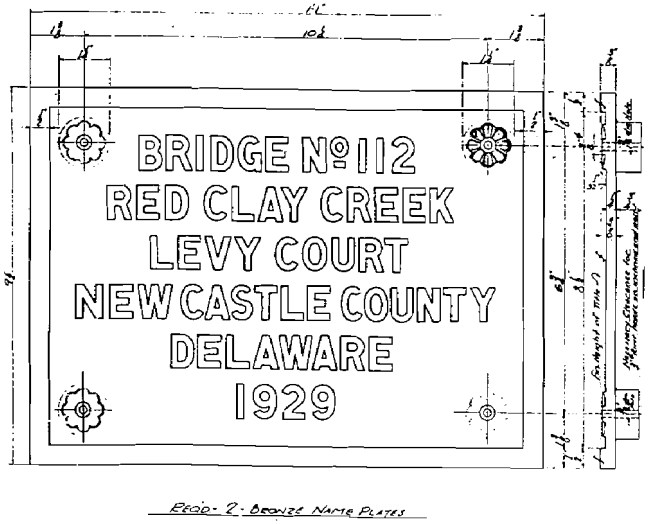
State Bridge 112

STATE BRIDGE 112

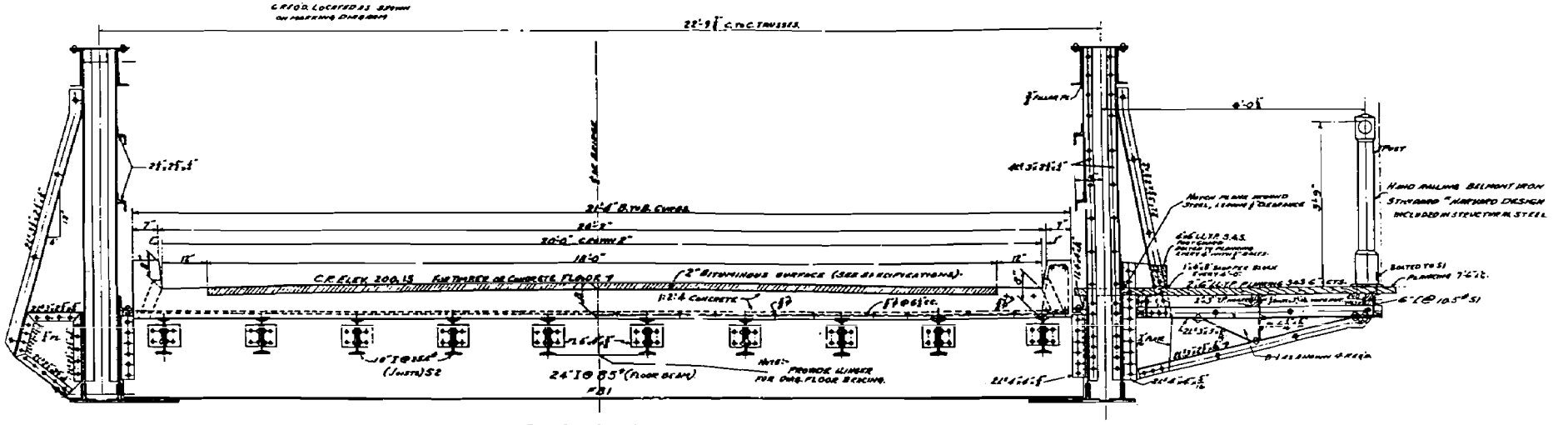
Yorklyn Road over Red Clay Creek Hockessin, New Castle County, Delaware 1929

State Bridge 112 is a 75'-0" steel riveted Warren pony truss, divided into five panels. The top chords and inclined end posts are double 10" channels riveted together by a cover plate at the top and laced at the bottom; the diagonals and bottom chords are made of 5"x3½" angles with stay plates. Vertical posts are built-up members incorporating 2½" x 3" angles. The timber deck is supported on six transverse girders spanned by ten longitudinal I-beams; it carries two lanes of traffic with a curb-to-curb width of 20'-0". There is a sidewalk with wood decking cantilevered off the east elevation with an ornamental steel railing. The superstructure is supported on concrete abutments with U-shaped wing walls; the wing walls rise above the level of the roadway to create concrete end blocks decorated with an incised panel. Bridge plates at either end document the date of construction.

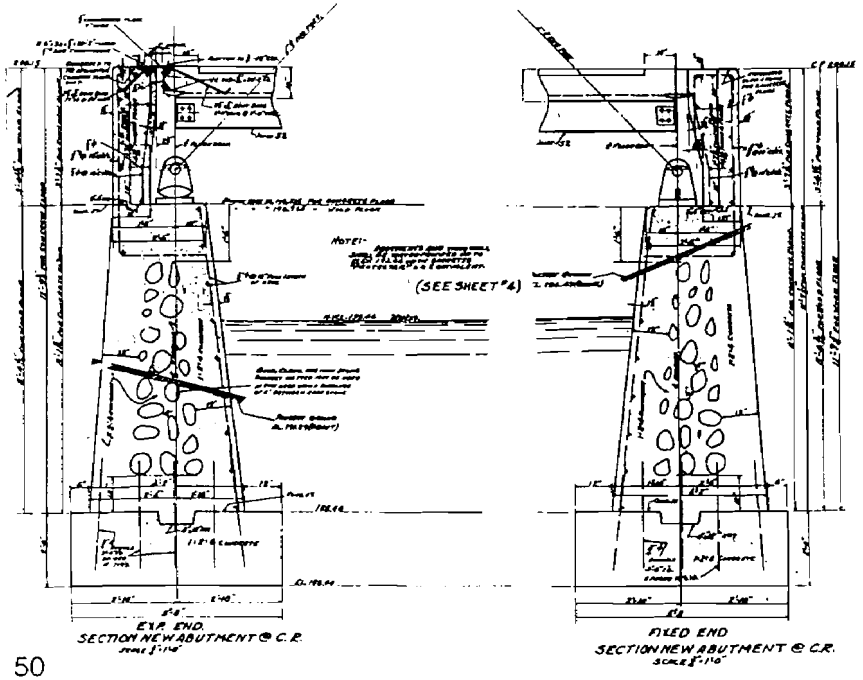
Delaware Department of Transportation records state that Bridge 112 was built in 1929 by authority of the New Castle County Levy Court. It was designed by the County Engineer's office and plans are on file at Delaware Department of Transportation. Excerpts from these plans appear on the adjacent page. The structural steel was fabricated by the Belmont Ironworks of Philadelphia, Pennsylvania, as was the handrail, which was specified standard "Harvard Design " or equivalent. The 1929 structure replaced an earlier bridge and incorporated portions of the previous substructure. The specifications called for reuse of the abutments from the previous structure, if feasible.

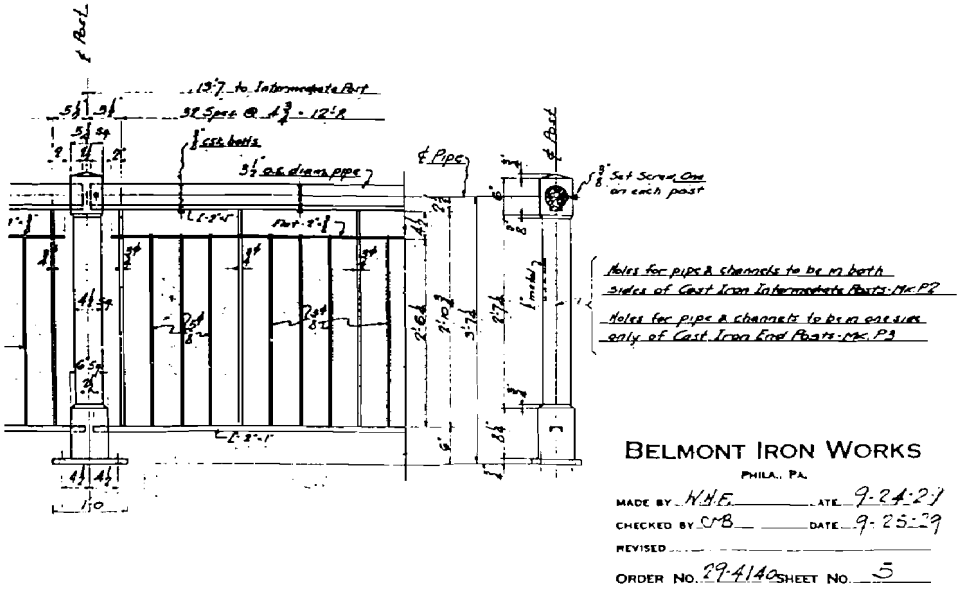


Plaque detail from original 1929 drawings for Bridge 112.

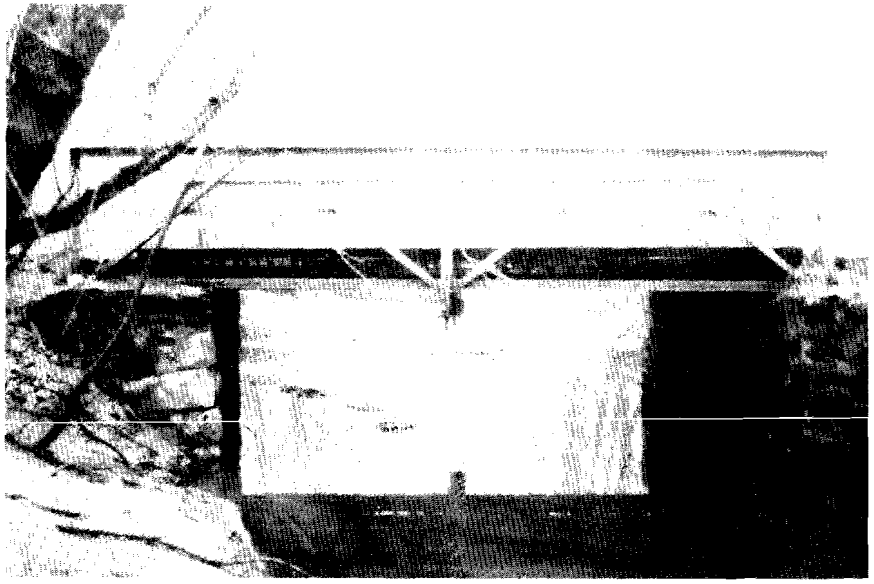


CROSS SECTION
SHOWING CONCRETE SLAB AND TIMBER SIDEWALK.

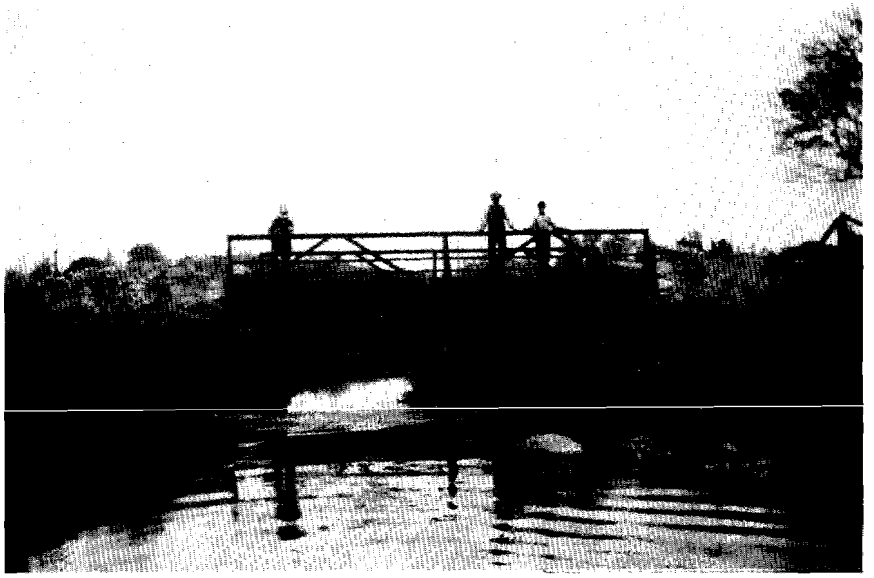




Excerpts from original 1929 drawings for Bridge 112.



State Bridge 179A



Bridge 179A as it appeared in 1921.

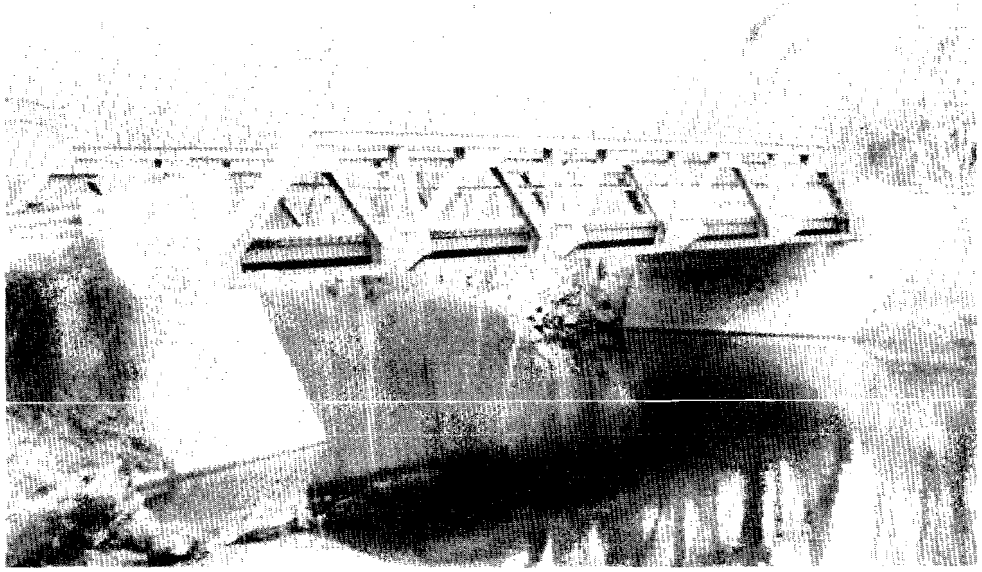
STATE BRIDGE 179A

Ashland Cut-off over Mill Creek Hockessin, New Castle County, Delaware

State Bridge 179A is a 20-0" Warren pony truss with riveted and welded connections, divided into two panels. The top and bottom chords are made of double 3" angles; posts are 2½" angles, and diagonals are double 2½" angles. A transverse floor beam (8" I-section) is located at the intermediate panel point; eight longitudinal girders support the steel grating deck, which measures 12'-10" curb-to-curb and carries one lane of traffic. The superstructure is supported on semi-coursed rubble stone abutments; there is only one wing wall, on the southeast elevation, of uncoursed rubble masonry and flared configuration.

Delaware Department of Transportation records for Bridge 179A do not document the date of construction. It is very similar to Bridge 66. Minor repairs amounting to $340.00 were performed in 1926. Plans for a 1928 repair drawn by the New Castle County Engineer's Office are on file at the Delaware Department of Transportation. These plans call for the reconstruction of one rubble masonry abutment and the underpinning of the other.

State Bridge 179A is significant as one of six intact historic metal truss highway bridges in Delaware. Structurally similar to Bridges 66 and 424, produced by the prominent Edge Moor Iron Company of Wilmington, Delaware, Bridge 179A may be a product of that manufacturer as well.



State Bridge 216

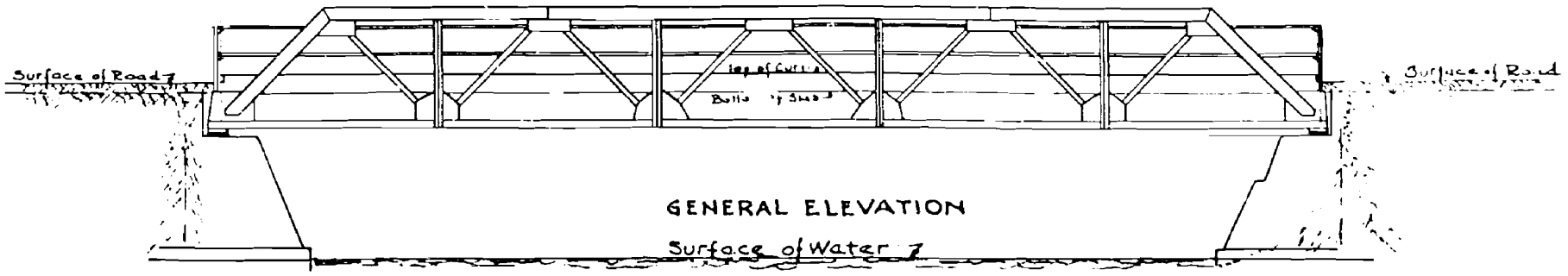
STATE BRIDGE 216

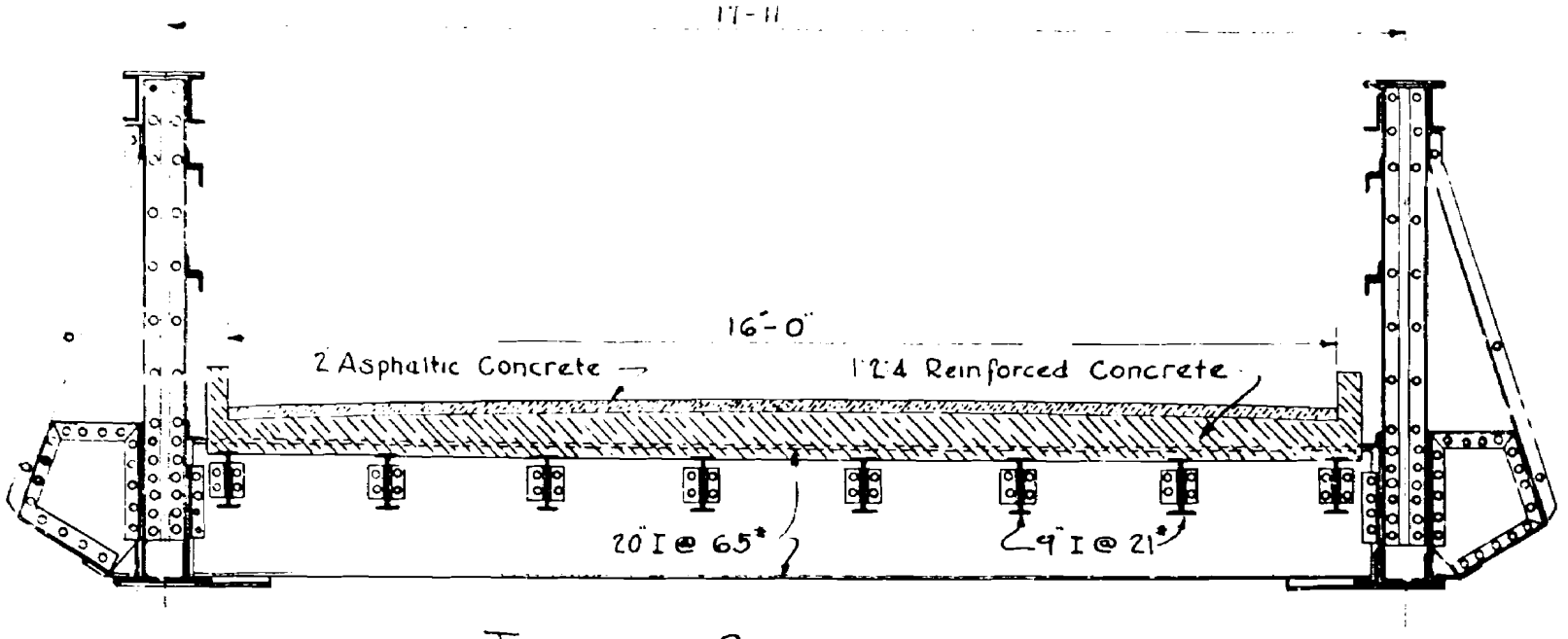
Chambers Rock Road over White Clay Creek
Newark, New Castle County, Delaware
1928

State Bridge 216 (Thompson's Station Bridge) is a 66'-82" riveted Warren pony truss, divided into five panels. The top chords and end posts are made of double 8" channels with cover plates at the top and lacing on the bottom; the diagonals and bottom chords are made of double 5"x 3½" angles with stay plates; and the posts are built-up members comprising angles and plates. The transverse floor beams extend beyond the truss to support angle A-braces for the posts. One lane of traffic is carried on the 16'-5" wide steel deck. The truss is supported on stone abutments with U-shaped stone wing walls; the substructure has been parged with concrete. A plaque on the north portal indicates the 1928 construction date.

Delaware Department of Transportation records state that Bridge 216, was built in 1928 by authority of the Levy Court of New Castle County. It was designed by the County Engineer's office and plans are on file at the Delaware Department of Transportation. Excerpts from the plans are presented on the following page. The contractor is undocumented; structural steel was fabricated by the Belmont Ironworks of Philadelphia, Pennsylvania.

METAL TRUSS





TYPICAL SECTION

Excerpts from original 1928 drawings for Bridge 216.

State Bridge 424

Bridge 424 as it appeared in 1921.

STATE BRIDGE 424

Road 446 over Wiggins Mill Road Townsend, New Castle County, Delaware

State Bridge 424 is a 34'-0" riveted Warren pony truss, divided into three panels. The top and bottom chords and diagonals are fabricated from double 3½" x 3½" angles; posts are 3½" x 3½" angles. Transverse floor beams are located at each panel point; they extend beyond the truss to support angle "A" braces for the posts. Longitudinal beams comprise both girders and doubled 4"x10" timbers, supporting a timber deck of 4"x8" boards. Constructed at a 15-degree skew, the bridge has abutments and flared wing walls of semi-coursed rubble masonry. It carries one lane of traffic on a 14'-8" wide deck.

Delaware Department of Transportation records indicate that Bridge 424 was built in 1884, replacing a bridge of unknown type. "Rebuilt 1884 J.T. Taylor, L.C. Com." is inscribed in the southwest wing wall. The Edge Moor Bridge Works of Wilmington, Delaware fabricated the superstructure. Bridge 424 is an intact surviving example of a number of Edge Moor pony trusses built in New Castle County between 1880 and 1900. Another surviving example is Bridge 66 (Breck's Lane Bridge).